U.S. Department Of Transportation
Federal Aviation Administration

Time-Based Flow Management (TBFM)

SYSTEM SPECIFICATION DOCUMENT (SSD)

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Change History

Version	Date	Change Description
1.0	11/13/2009	Initial Version

1 Background

This System Specification Document (SSD) establishes the requirements for the Time-Based Flow Management (TBFM) Program. The requirements are developed in accordance with the Federal Aviation Administration (FAA) System Engineering Manual (SEM). The TBFM program will develop and implement the new capabilities in the FY2010-2015 timeframe. The overall goal of TBFM is to maximize use of available National Airspace System (NAS) resources, while minimizing delays and disruptions to aircraft operators and their customers, as well as reducing fuel burn and engine emissions thereby decreasing user operational costs. TBFM will support Traffic Flow Management (TFM) in satisfying the requirements identified in the "TFM Mission Need Statement (MNS), Revalidated," MNS-307, dated April 22, 2002 and the Next Generation Air Transportation System (NextGen) Operational Improvements (OI) in the NextGen Implementation Plan. This requirements document shall be used in conjunction with existing FAA approved Traffic Management Advisor (TMA) documentation.

1.1 Scope

This SSD details the requirements and initiatives that the TBFM program office in AJR has identified to upgrade and enhance the operational TMA. These initiatives position the FAA to transition to the NextGen vision of improved air traffic management, while improving NAS capacity, efficiency, safety and airline fuel consumption.

TBFM expands the role and scope of TMA time-based metering (TBM) operations providing benefits more widely throughout the NAS and contributes to the achievement of the following NextGen OI and Decision Points (DP) within the NAS Enterprise Architecture.

- OI 104120 – Point in Space Metering
- OI 104122 – Integrated Arrival Departure Airspace Management
- OI 104123 – Time-Based Metering using RNAV and RNP Route Assignments
- DP 195 – TBFM Final Investment Decision
- DP 44 – TBFM/Integrated Enterprise Solution (IES) Initial Investment Decision
- DP 57 – TBFM/IES Final Investment Decision

The TBFM development performance period is 2010-2015, followed by Integrated Enterprise Solution (IES), which integrates TBFM functionality into En Route Automation Modernization (ERAM) and/or Traffic Flow Management System (TFMS) in the long term by 2025.

1.1.1 Current TMA Operations

The TMA system has proven successful in managing arrival traffic flows to major airports in the NAS. TMA is operational at 20 Air Route Traffic Control Centers (ARTCC) and the associated Terminal Radar Approach Control (TRACON) facilities and towers. En Route Departure Capability (EDC) is a recent TMA enhancement that extends its benefits by supporting scheduling of departures to pre-defined points in En Route airspace.

TMA computes flight arrival sequencing, unconstrained Estimated Times of Arrival (ETA), and corresponding Scheduled Times of Arrival (STA) at various points along the aircraft flight path to an airport. These points include outer meter arc(s), the meter fix (MF)/arc, and the final approach fix and/or runway threshold. In response to changing events and controller inputs,

TMA provides STAs and delay times to the respective en route controller to maintain optimum flow rates to runways from the ARTCC to the TRACON. TMA accomplishes this by providing continual updates of MF ETA and delay information (the difference between the STA and ETA) at a speed comparable to the live radar update rates.

TMA calculates a schedule for arriving aircraft derived from system information such as the threshold matrix or separation required between different aircraft, and any other constraints in effect. This schedule is used to set an arrival rate or range to meet TRACON facility acceptance rates set by the Traffic Management Coordinator (TMC).

1.1.1.1 Time-Based Metering (TBM)

TBM is a systemic means to dynamically manage demand/capacity imbalances via time, versus traditional static miles-in-trail (MIT) traffic management techniques. TBM can be applied in either the arrival and/or en route/departure domains. Controllers meter aircraft to meet TMA-assigned STAs using the time information displayed in the meter list shown on the controller displays.

1.1.1.2 Adjacent Center Metering

Adjacent Center Metering (ACM) extends TBM beyond the boundaries of one ARTCC. ACM enables adjacent ARTCCs to assist downstream, space-constrained ARTCCs to conduct TBM and allocate NAS resources more efficiently. When an ARTCC sector has little airspace/time to absorb delay to the TRACON boundary, the adjacent ARTCC helps by metering their arrivals prior to handoff to the ARTCC. The data generated by the TMA system at the primary ARTCC is displayed simultaneously on the adjacent ARTCC's Display System Replacement (DSR) consoles for aircraft bound to the TRACON.

1.1.1.3 En Route Departure Capability

TMA also provides limited departure sequencing through the En Route Departure Capability (EDC). EDC is an enhancement added to TMA to support metering at points on the boundaries between facilities. Users are able to optimize streams of aircraft leaving their facility and schedule departures from internal airports to merge with other traffic. Users are able to specify scheduling constraints and display time-ordered schedules and geographic views of position data.

1.1.1.4 Virtual Network Computing (VNC)

The Virtual Network Computing (VNC) Manager is a software tool that allows Air Traffic Control System Command Center (ATCSCC) personnel to view and/or interact with remote TMA installations. The VNC Manager operates in two modes:

- Read: Allows a user to view what is displayed on the selected workstation
- Read/Write: Allows a user to view and interact with the information that is displayed on the selected workstation

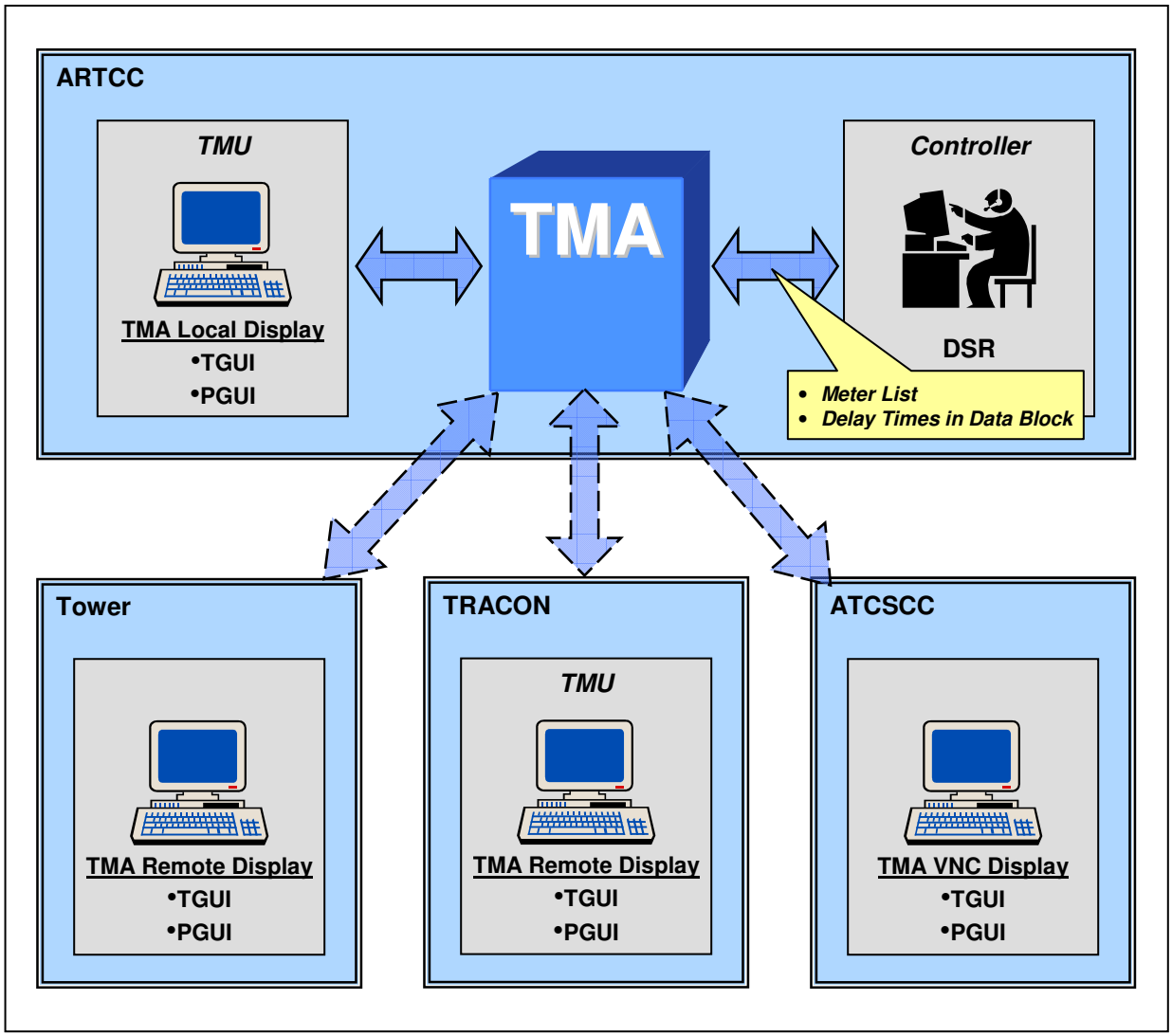

Figure 1: TBFM Display Architecture

Figure 1 illustrates the TBFM display architecture, including the VNC display at the ATCSCC. ATCSCC personnel have access to TMA displays from select sites via VNC Manager. The VNC Manager provides the common situational awareness of the ARTCC, adjacent ARTCCs, TRACON, and Tower facilities, which have TBFM displays. The ATCSCC can view these non-controlling displays on the VNC Manager PCs and can access the same preference files used by each facility. ATCSCC personnel are only able to change the display of these non-controlling displays with no ability to affect TBFM scheduling operations at the site. VNC technology is not currently operational at any other TBFM site.

1.2 Time-Based Flow Management (TBFM) Operational Concept

TBFM expands the role and scope of TBM operations to provide benefits more widely throughout the NAS. TBFM will achieve and close the performance gap in transitioning TMA through the follow-on IES system fulfilling operational user needs and NextGen goals.

The TBFM program will work in concert with the programs of current and future Air Traffic Control (ATC) Automation systems, such as ERAM, TFMS, Automated Radar Terminal System (ARTS), and Standard Terminal Automation Replacement System (STARS). Throughout the enhancements, services will continue to be essential and provided around the clock.

Figure 1 represents the operational concept for TBFM. As indicated in the figure, TBFM expands the role and scope of TBM operation. TBFM is a continuation and support of TMA which is at end of its life-cycle.

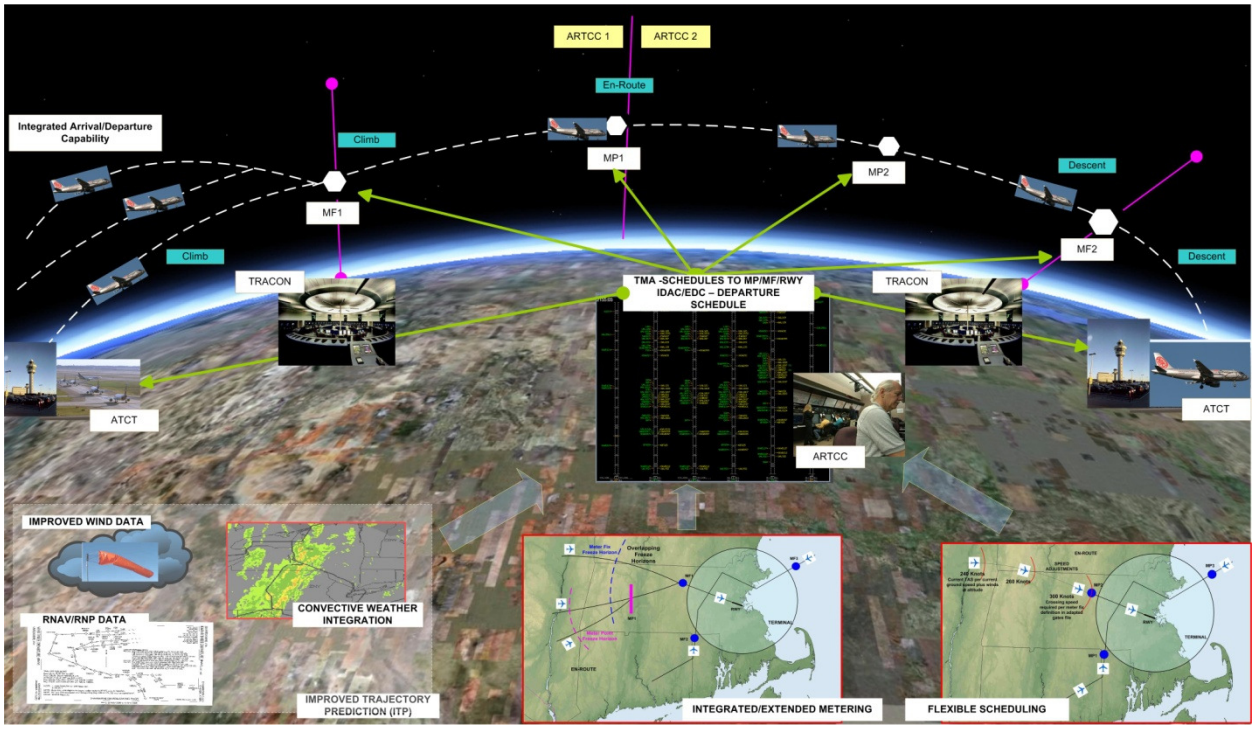

Figure 2: High-Level Operational Concept Graphic (OV-1) - Time-Based Flow Management

The following descriptions depict the TMA shortfalls and the planned TBFM enhancements to overcome those shortfalls.

1.2.1 Extended Metering Part 1

Currently in TMA, Meter Reference Elements (MRE) (which include arcs, points, MFs, runway threshold and final approach fixes) are supported in the terminal and ARTCC airspace as scheduling entities. These scheduling entities enhance the ability of ARTCCs to conduct TBM of arrivals over long distances from the arrival airport and to meter en route traffic flows.

TBFM Extended Metering Part 1 is an enhancement that allows linking of MREs and extends TBM for flights from their point of departure, through MREs in en route airspace, to their destination facility. TBFM Extended Metering Part 1 allows one additional MRE to be configured in En Route air space, beyond the first tier of MREs. This MRE can be configured within the same TBFM system or separate TBFM systems. It allows a MRE to be linked to

another MRE. This allows metering in the cruise phase to schedule active flights in overhead streams, schedules departures with other departures and active flights into overhead streams, and configures the TMC display to show any set of timelines. The extension of the scheduling capability will reduce the build-up of error that occurs when ETAs are predicted over long distances.

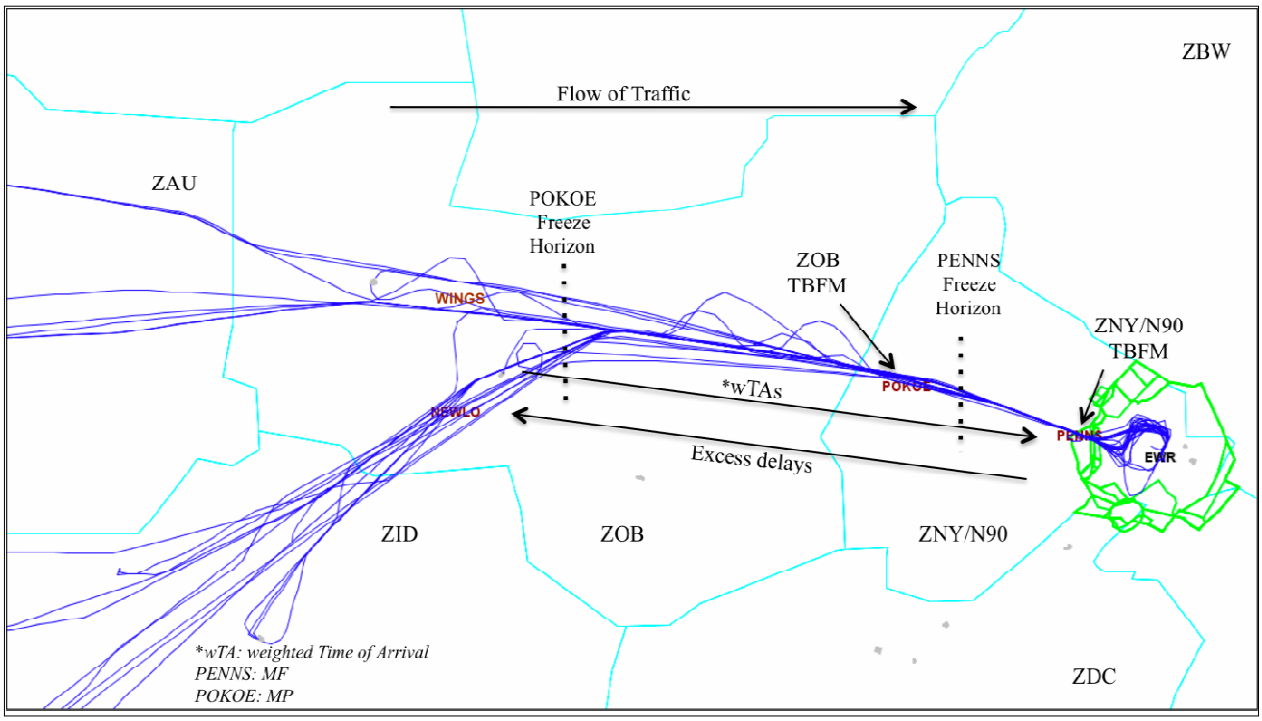

Figure 3: Extended Metering Part 1

Extended Metering Part 1 will help position the FAA to transition to the NextGen vision of increased air traffic management, while improving NAS capacity and efficiency.

1.2.2 System Re-architecture

TMA was originally architected in the 1990's and incorporated limited upgrades in 2004 with limited connectivity and interaction with systems. Since that time, some of the interfaces have been updated to adhere to the System Wide Information Management (SWIM) standards. Additionally, the current TMA hardware faces a number of obsolescence issues, which are not easily addressed due to changes in the computer hardware marketplace. The current Monitor and Control (M&C) requires a manual process to set up (or re-set up) the configuration. A complete TMA system re-architecture including hardware, software, CHI, and operating system is needed. TBFM system re-architecture enhancement upgrades the system architecture to: reduce cost of ownership; reduce the logistical footprint; maintain compatibility of hardware and software; comply with system performance requirements; and to increase the flexibility of workstations. TBFM re-designs and re-implements the M&C to simplify monitor and control. One of the key objectives of the re-architecture is identifying CHI enhancements and core interface components

to increase TBFM system operational effectiveness and simplify training. The intent is to modify, improve and expand the human-to-system interaction including ease of use, utilization of system functions, and consistency of us. The configuration process is independent of the M&C function. As part of this re-architecture piece, TBFM interfaces will be modified to support the SWIM standards

An engineering subsystem will give the TMC the ability to see the effects of contemplated metering constraint changes prior to implementing those changes. Newer weather data will use more accurate winds and temperature aloft data in the generation of 4D trajectory calculations to improve ETAs. TBFM also includes a built-in analysis capability that identifies performance measures for improved effectiveness.

1.2.3 Flexible Scheduling

Currently, during peak arrival periods in which the TMA tool is being used to meter aircraft, capacity, scheduling may be inefficient. This inefficiency is partially a result of TMA's inability to take advantage of open spaces in a traffic flow schedule, which then cause that space to go unused. Another reason for this inefficiency is due to TMA's inability to model slight increases in an aircraft's speed in order to find an open space in traffic flow schedule.

TBFM allows for greater flexibility in the scheduling process by minimizing the occurrence of open spaces in the TBFM schedule. A key principle of flexible scheduling takes into account the practical limitations and uncertainty of estimating times of arrival to the scheduling points in order to allow for a greater range (greater degree of freedom) of possible times that can be passed to the scheduling process. This is especially important in today's TBM operations as wake vortex runway separation is used in lieu of airport arrival rates. The flexible scheduling capability utilizes scheduling techniques to create a more optimal schedule to utilize achievable ETAs and STAs and allows aircraft to take advantage of unused airspace capacity.

Accelerated arrivals and departures expand upon this concept of flexible scheduling and allows for slight and achievable increases in an aircraft's speed to be modeled in order to take advantage of unused airspace capacity. Accelerated arrivals and departures capability requires physical acceleration of an aircraft by an Air Traffic Controller in order to achieve a slightly faster time.

Small differences in ETAs result in unused portions of unused open spaces (partial slots). As figure 3 illustrates, an open space (partial slot) not only results in delay associated with the aircraft directly following an aircraft, but it also has a transitive effect on aircraft that follow the directly impacted aircraft.

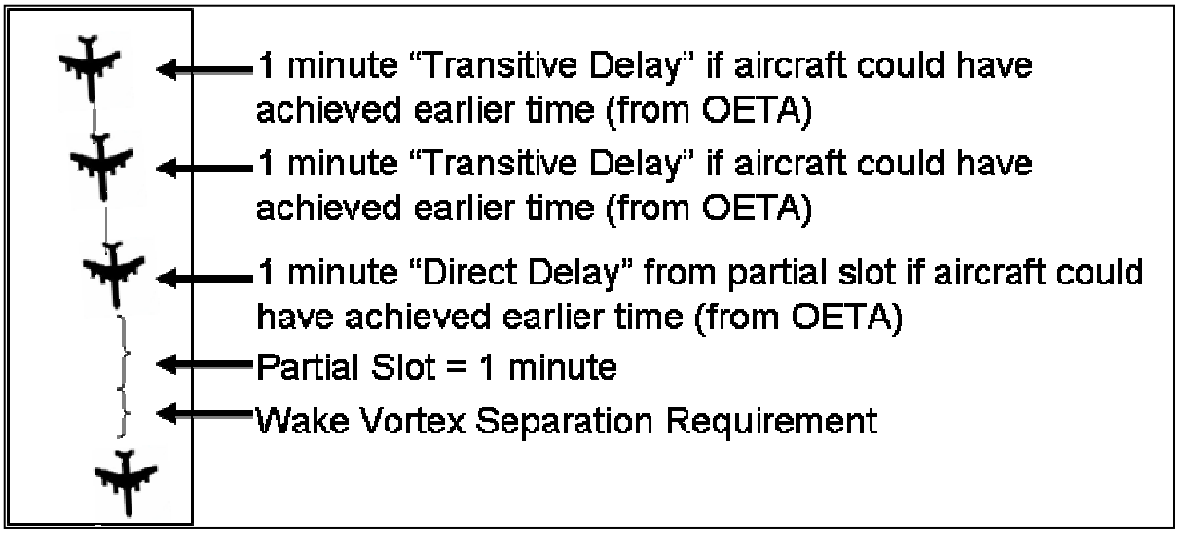

Figure 4: Open Space or "Partial Slot" Transitive Delay Impact Potential

1.2.4 Convective Weather Display

Weather has a great impact on air traffic, and consequently on the predictability needed for TBM. Showing current and forecast convective weather on the displays allows traffic managers to better determine when to suspend and resume metering operations in the presence of convective weather or to alter the flow of traffic around or over the weather cells. This helps traffic managers better determine when to suspend and resume metering operations in the presence of convective weather or to alter the flow of traffic around or over the weather cells. Providing convective weather information on TBFM displays allows traffic management personnel to see current and forecasted routes being impacted. Providing better predictability of available routes allows the TBFM operator to continue TBM during periods of convective weather.

1.2.5 TBFM Information Sharing

The Information Sharing enhancement allows TBFM, other NAS systems and industry to collaborate, share TBFM data and be informed of TBFM STAs that are in effect during metering events. TBFM also shares information between TBFM systems within the same facility and between TBFM at multiple facilities.

TBFM will leverage the SWIM Service Oriented Architecture (SOA) infrastructure and standards to promote information sharing.

The airlines' usage of TMA data will enable airline schedulers/dispatchers to have more accurate flight plan and flight crew-adjusted estimate of time of arrivals to make better hold/go decisions, more effectively manage ground resources, and support strategic fleet planning decisions.

1.2.6 Implement Area Navigation (RNAV) and Required Navigation Performance (RNP) Routes and Procedures

The FAA continues to increase the development of Area Navigation (RNAV) and Required Navigation Performance (RNP) routes and procedures that allow eligible aircraft and flight crews' access to specified 3D paths when aircraft performance can meet the performance specified by the published route. The increased availability and usage of RNAV/RNP routes and procedures within the NAS provides a significant opportunity for TBFM. In addition to the En Route RNAV routes, which are already available in the TMA adaptation, the TRACON RNAV routes for both departures Standard Instrument Departure (SIDs) and arrivals Standard Terminal Arrival Rate (STARs) automatically download and are used to update site adaptation.

The enhancement to implement RNAV/RNP routes and procedures into TBFM changes TBFM trajectory prediction, supporting adaptation, and scheduler constraints. These changes facilitate more accurate ETAs for arrival and departure aircraft.

1.2.7 Integrated Arrival/Departure Capability

Integrated Arrival/Departure Capability (IDAC) increases NAS efficiency and reduces delays by providing decision making support capabilities for departure flows. Figure 5 depicts standard departure flow problems that IDAC addresses. The blue flights (upper left) represent departures from multiple airports merging over a common departure fix. The green flights (lower right) show departures merging into an overhead flow.

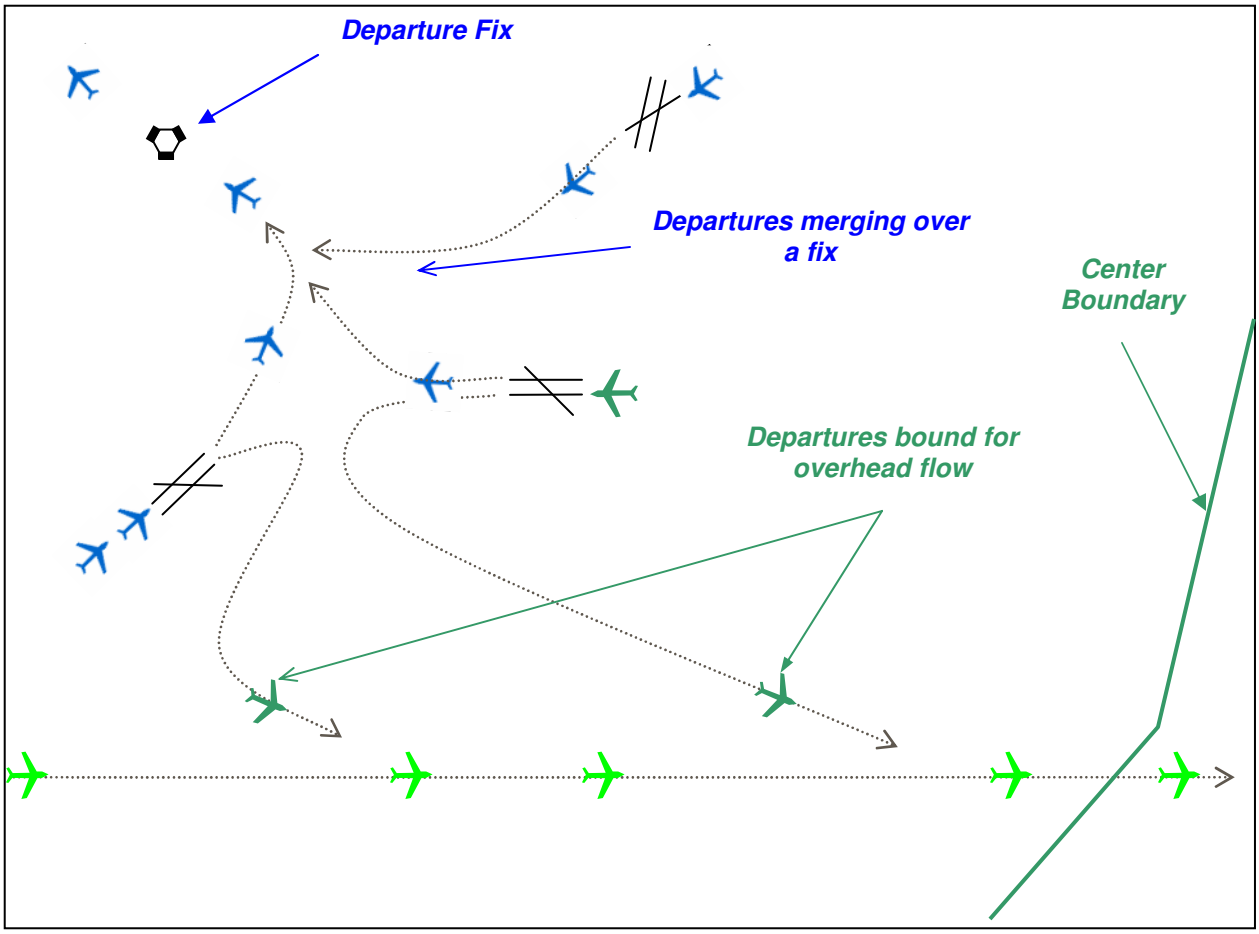

Figure 5: Integrated Departure/Arrival Capability

IDAC automates the process of monitoring departure demand and identifying departure slots. IDAC coordinates the departure times between airports and provides situational awareness to Air Traffic Control Towers (ATCT) so that they can select from available departure times and plan their operation to meet these times. The results of these enhancements are more efficient departure flows and less delay.

2 Applicable Documents

The following specifications, standards, instructions, orders, guidelines and handbooks form a part of this document and are applicable to the extent specified herein. The latest version of these documents shall apply. In the event of a conflict between the referenced documents and the SSD, the SSD shall take precedence.

2.1 Reference Documents

1. Final Program Requirements for Time-Based Flow Management (TBFM), July 1, 2009
2. System Specification: Traffic Management Advisor (TMA), 25 June 2009, FAA-E-2971, Draft Rev O
3. High-Level Operational Concept Graphic (OV-1) – Time-Based Flow Management, March, 2009

2.2 Compliance Documents

2.2.1 Specifications and FAA Orders

FAA Order 1053.1	Energy and Water Management Program for FAA Buildings and Facilities
FAA Order 1280.1	Protecting Personally Identifiable Information (PII)
FAA Order 1350.14	Federal Records Management Policy
FAA Order 1350.15	Records Organization, Transfer, and Destruction Standards
FAA Order 1370.100	Media Sanitizing and Destruction Policy
FAA Order 1370.101	ATO Information Security Incident Reporting and Response Policy
FAA Order 1370.102	System Use Notification and Disclaimer Statement Policy
FAA Order 1370.107	Rules of Behavior/System Use Policy
FAA Order 1370.82	FAA Information Systems Security (ISS) Program
FAA Order 1370.83	Internet Access Points
FAA Order 1370.89	Information Operations Condition
FAA Order 1370.91	Information System Security Patch Management
FAA Order 1370.96	ATO System Access Control
FAA Order 1375.1	Data Management
FAA Order 1600.1	Personnel Security Program
FAA Order 1600.2	Safeguarding Classified National Security Information
FAA Order 1600.69	FAA Facility Security Management Program
FAA Order 1900.47	Air Traffic Organization Operational Contingency Plan
FAA Order 3900.19	Occupational Health and Safety Program
FAA Order 4600.XX	Asset Identification Specification
FAA Order 6000.22	Maintenance of Analog Lines
FAA Order 6000.30	National Airspace System Maintenance Policy

FAA Order 6000.36	Communications Diversity
FAA Order 6000.47	Maintenance of Digital Transmission Channels
FAA Order 6000.53	Remote Maintenance Monitoring Interfaces
FAA Order 6470.33	Control of Power, Space, and Environmental Interfaces at En Route ATC Facilities
FAA Order 6650.8	Airport Fiber Optic Design Guidelines.
FAA Order 6950.2	Electrical Power Policy Implementation NAS Facilities
FAA Order 6950.22	Maintenance of Electrical Power and Control Cables
FAA Order 7032.9	Traffic Management System (TMS) Air Traffic Operational Requirements
FAA Order 7210.3	Facility Operation and Maintenance
FAA Order N1370.92	Password and PIN Management in the FAA

2.2.2 Standards

FAA-C-1217	Electrical Work, Interior
FAA-G-2100	Electronic Equipment and General Requirements
FAA-HFDS	FAA Human Factors Design Standard
FAA-STD 019	Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment
FAA-STD 020	Transient Protection, Grounding, Bonding and Shielding Requirements for Electronic Equipment
FAA-STD-025	Interface Control Document
FAA-STD-026	Software Development for the National Airspace System
FAA-STD-039	NAS Open System and Protocols
FAA-STD 063, 064, 065 and 066	SWIM Service Specification Document

2.2.3 Other Documents

29 CFR 1910	Safety and Health Provisions for Federal employees
29. NAS MD-850	Central Flow Automation Facility (CFAF) - NAS Stage A En Route Host Computer System (HCS)
ANSI Grade B Bar Code Standard	Bar Code Print Quality Guideline, X3.182
ANSI/EIA-649	National Consensus Standards for Configuration Management
ANSI/EIA-748	Value Management System (EVMS) Guidelines
ANSI/ISO/ASQ Q9001-2000	Quality Management Standard
ANSI/TUT IEC 60068 .1	Environmental Testing- General and Guidance

CFR Title 29 CFR 1910.95	Occupational Safety and Health Standards
DD Form 1586	Contract Funds Status Report
DOD STD-5200.28	Trusted Computer System Evaluation Criteria
Executive Order 12196	Occupational Safety and Health Program for Federal Employees
Executive Order 12902	Energy Efficiency and Water Conservation At Federal Facilities, The Energy Policy Act of 1992
FAA-D-2494	Technical Instruction Book Manuscript: Electronic, Electrical, and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books

3 Requirements

This section provides the TBFM program requirements. The intent of the underlined requirements in this section is to denote requirements that either in whole or in part implement the TBFM enhancements discussed in Section 1. Note that any requirement in this document may impact the TBFM system.

3.1 System Description

The TBFM program is a key element of the FAA TFM operational environment. TBFM's focus is to more efficiently utilize the available airport capacity without decreasing safety or increasing controller workload. TBFM accomplishes this by providing automation aids for scheduling and metering flights to assist in optimizing:

- Airborne and arrival traffic flows
- Departure flows
- Departure flows into airborne and arrival traffic flows
- Coordinated scheduling of traffic flows across adjacent facilities
- Flexible scheduling of unused airspace capacity
- Accuracy of scheduling information
- Exchange of TBFM scheduling information
- Situational display of weather impacts to traffic flow schedules
- Unused airspace capacity

3.2 Functional Capabilities

3.2.1 TBFM Processing

3.2.1.1 General Requirements

3.2.1.1.1 TBFM **shall (SSD1)** provide its functionality at specified ATC facilities.

3.2.1.1.2 TBFM **shall (SSD2)** utilize a SOA model to exchange information based on FAA approved SWIM standards.

3.2.1.1.3 The TBFM-SWIM interface architecture elements **shall (SSD3)** comply with the SWIM architecture based on established SWIM standards.

3.2.1.2 Receive, Process, Update and Maintain Flight Information

3.2.1.2.1 TBFM **shall (SSD4)** receive and process flight information from Government-approved sources.

3.2.1.2.2 TBFM **shall (SSD5)** provide the capability to combine flight information from multiple Government-approved sources.

3.2.1.2.3 TBFM **shall (SSD6)** create, modify, update, or delete flight information throughout the flight to reflect the flight's status and intended flight path.

3.2.1.2.4 TBFM **shall (SSD7)** process and update flight information for flights that have a flight plan filed with the FAA but have not yet become airborne.

3.2.1.2.5 TBFM **shall (SSD8)** detect the following flight events and record the times at which they occur.

a. arrival at destination airport
b. departure from originating airport
c. fix crossing
d. entry to or exit from facility airspace.

3.2.1.2.6 TBFM **shall (SSD9)** maintain and store flight information for inactive flights based on a system-configurable time after the proposed departure time.

3.2.1.2.7 TBFM **shall (SSD10)** store and use flight information to generate reports..

3.2.1.3 Receive, Process, Maintain, and Update Weather Information

3.2.1.3.1 TBFM **shall (SSD11)** receive and process weather information from FAA approved sources.

3.2.1.3.2 TBFM **shall (SSD12)** use the latest weather information for display and processing.

3.2.1.3.3 TBFM **shall (SSD13)** archive weather information.

3.2.1.4 Evaluate and Generate Tactical Traffic Management Initiatives

3.2.1.4.1 Meter Reference Element

3.2.1.4.1.1 TBFM **shall (SSD14)** accept user requests to create Meter Reference Elements (MRE) for the purpose of scheduling and delay distribution.

3.2.1.4.1.2 TBFM **shall (SSD15)** accept user requests to create traffic flow definitions for each MRE.

3.2.1.4.1.3 TBFM **shall (SSD16)** assign MREs to a flight.

3.2.1.4.1.4 TBFM **shall (SSD17)** allow sets of MREs to be linked along extended routes of flight.

3.2.1.4.2 Trajectory Modeling

3.2.1.4.2.1 TBFM **shall (SSD18)** be capable of receiving, storing and processing published NAS route information.

3.2.1.4.2.2 TBFM **shall (SSD19)** model a flight's trajectory to determine the ground track, altitude and speed profile.

3.2.1.4.2.3 TBFM **shall (SSD20)** assign each flight to a traffic flow definition whenever that flight is added to the system for the purpose of trajectory calculation and scheduling.

3.2.1.4.2.4 TBFM **shall (SSD21)** be able to create a holding area for the purpose of consuming delay.

3.2.1.4.2.5 TBFM **shall (SSD22)** be capable of assigning a holding area to a flight.

3.2.1.4.2.6 TBFM **shall (SSD23)** accept user request to specify current airport configuration.

3.2.1.4.2.7 For each flight, TBFM **shall (SSD24)** calculate and update trajectories to all possible runways as determined by operational constraints (e.g. airport configuration, TRACON operations, etc).

3.2.1.4.2.8 TBFM **shall (SSD25)** assign each aircraft a traffic flow definition when a MRE or arrival configuration changes for that particular aircraft.

3.2.1.4.2.9 TBFM **shall (SSD26)** update the assignment of MREs to a flight whenever a change in flight information or airspace configuration occurs.

3.2.1.4.2.10 TBFM **shall (SSD27)** perform trajectory calculation corrections when an aircraft position varies from the converted route as defined by configurable parameters.

3.2.1.4.2.11 TBFM **shall (SSD28)** calculate the estimated time of arrival (ETA) at MREs to support departure, En Route, and arrival scheduling.

3.2.1.4.2.12 TBFM **shall (SSD29)** perform trajectory calculations from a MRE to a linked, downstream MRE.

3.2.1.4.2.13 TBFM **shall (SSD30)** limit the fluctuation of an aircraft's ETA due to estimation errors.

3.2.1.4.2.14 TBFM **shall (SSD31)** provide the ETA at MREs to external systems.

3.2.1.4.3 Process Aircraft scheduling

3.2.1.4.3.1 TBFM **shall (SSD32)** process all user-entered schedule entries.

3.2.1.4.3.2 TBFM **shall (SSD33)** sequence and schedule aircraft to a MRE on a first-come-first-served (FCFS) basis while conforming to traffic flow definitions.

3.2.1.4.3.3 TBFM **shall (SSD34)** calculate a schedule for all aircraft to various MREs which optimizes utilization of airspace but does not exceed the specified capacity.

3.2.1.4.3.4 TBFM **shall (SSD35)** calculate a coordinated schedule for linked MREs.

3.2.1.4.3.5 TBFM **shall (SSD36)** allow the linked MREs to exchange information.

3.2.1.4.3.6 TBFM **shall (SSD37)** be capable of resolving schedule conflicts at MREs.

3.2.1.4.3.7 TBFM **shall (SSD38)** be capable of removing a flight from the schedule when flight information or user input dictates.

3.2.1.4.3.8 TBFM **shall (SSD39)** process a previously removed flight as a newly eligible flight.

3.2.1.4.3.9 TBFM **shall (SSD40)** schedule tracked and proposed flights associated with adapted airports.

3.2.1.4.3.10 TBFM **shall (SSD41)** accept user requests to manually schedule proposed flights.

3.2.1.4.3.11 TBFM **shall (SSD42)** provide the capability to dynamically create groups of MRE restrictions.

3.2.1.4.3.12 TBFM **shall (SSD43)** accept user requests to manually enter sequence constraints for MREs.

3.2.1.4.3.13 TBFM **shall (SSD44)** accept user requests for re-sequencing flights.

3.2.1.4.3.14 TBFM **shall (SSD45)** be capable of re-sequencing flights within the same traffic flow definition.

3.2.1.4.3.15 TBFM **shall (SSD46)** accept user requests to dynamically specify scheduling preferences for flights and/or flows.

3.2.1.4.3.16 TBFM **shall (SSD47)** accept user requests to exempt or un-exempt a flight from a traffic flow definition.

3.2.1.4.3.17 TBFM **shall (SSD48)** apply runway scheduling to the runway threshold or Final Approach Fix (FAF) depending on weather-related airport configuration.

3.2.1.4.3.18 TBFM **shall (SSD49)** internally assign flights to alternative (but allowed) runways to optimize the utilization of the airspace.

3.2.1.4.3.19 TBFM **shall (SSD50)** track diverted flights and add the flights to the diversion list.

3.2.1.4.3.20 TBFM **shall (SSD51)** calculate the scheduled time of arrival (STA) at MREs for arrival and departure scheduling.

3.2.1.4.3.21 TBFM **shall (SSD52)** be capable of defining the point when a flight reaches a distance or time from a MRE at which the flight's STA becomes locked.

3.2.1.4.3.22 TBFM **shall (SSD53)** continually update a flight's STA to a MRE until a specified STA locking point, if one is defined, is reached.

3.2.1.4.3.23 TBFM **shall (SSD54)** accept user requests to enable and disable the capability of locking aircraft STAs.

3.2.1.4.3.24 TBFM **shall (SSD55)** accept user requests to configure the distance or time from a MRE at which the STA becomes locked.

3.2.1.4.3.25 TBFM **shall (SSD56)** accept user requests to recalculate the locked STAs for flights that have not been manually scheduled.

3.2.1.4.4 Delay Processing

3.2.1.4.4.1 TBFM **shall (SSD57)** calculate the delay, which is the difference of ETA and STA, for each flight at each MRE.

3.2.1.4.4.2 TBFM **shall (SSD58)** calculate the maximum delay that can be absorbed in each facility's airspace.

3.2.1.4.4.3 TBFM **shall (SSD59)** be capable of distributing delays between MREs.

3.2.1.5 Departure Management

3.2.1.5.1 TBFM **shall (SSD60)** accept user requests to specify the default traffic flow definitions conformance priority order.

3.2.1.5.2 TBFM **shall (SSD61)** identify departure flights associated with a single or multiple MRE(s) for sequencing and scheduling.

3.2.1.5.3 TBFM **shall (SSD62)** calculate the departure release times for flights included in the MRE traffic flow definition.

3.2.1.5.4 TBFM **shall (SSD63)** assign a departure release time at the first available time at or after the departure release time requested by the user.

3.2.1.5.5 TBFM **shall (SSD64)** accept user requests to override any assigned departure release time.

3.2.1.5.6 TBFM **shall (SSD65)** accept user requests to assign a departure runway for a flight.

3.2.1.5.7 TBFM **shall (SSD66)** accept user requests to approve, un-assign, and change departure release times for flights subject to a traffic flow definition.

3.2.1.5.8 TBFM **shall (SSD67)** enable electronic negotiations between users for assigning, approving and acknowledging departure release times.

3.2.1.5.9 TBFM **shall (SSD68)** accept user requests to re-sequence departure release times for flights when they meet the following criteria:

- The flights have the same origin, and
- The flights are operated by the same aircraft category, and
- The flights are in pre-departure mode, and
- The flights are restricted by the same set of traffic flow definitions.

3.2.1.5.10 TBFM **shall (SSD69)** identify and display flights to a user that are impacted by a closed route.

3.2.2 Metering Monitoring, Analysis, Improvement and Reporting

3.2.2.1 TBFM **shall (SSD70)** be capable of accepting user requests to define performance data parameters for evaluating operational performance of the system for metering, sequencing and scheduling events during user-specified time-periods.

3.2.2.2 TBFM **shall (SSD71)** record operational information for metering, sequencing and scheduling event analysis for up to 72 hours.

3.2.2.3 TBFM **shall (SSD72)** have the capability to generate reports of recorded operational information.

3.2.2.4 TBFM **shall (SSD73)** accept user requests to generate, modify, delete, save, display and print user-defined reports.

3.2.2.5 TBFM **shall (SSD74)** generate user-defined reports that analyze prior metering, sequencing and scheduling events.

3.2.2.6 TBFM **shall (SSD75)** provide real-time automated recommended solutions on the configuration and system settings that can be utilized to optimize traffic flow.

3.2.2.7 TBFM **shall (SSD76)** provide the user the capability to cancel or enact the recommended solution.

3.2.2.8 TBFM **shall (SSD77)** provide the user the capability to enable or disable the display of real-time automated recommended solutions.

3.2.2.9 TBFM **shall (SSD78)** generate comparison reports on the configuration and system settings to optimize traffic flow based on historical data in user-defined format.

3.2.2.10 TBFM **shall (SSD79)** retain delay report files and make available a record of delay report files for a minimum of 15 days.

3.2.2.11 TBFM **shall (SSD80)** provide a report detailing results of diagnostics, inconsistencies, errors, and unknown data encountered.

3.2.3 Traffic Management Display System Requirements

3.2.3.1 Traffic Management Display Functionality

3.2.3.1.1 TBFM **shall (SSD81)** display all time in Coordinated Universal Time (UTC) format.

3.2.3.1.2 TBFM **shall (SSD82)** display schedule information, flight information, and MRE information from one or more facilities as text, graphs, timelines, planviews or reports as selected by user input.

3.2.3.1.3 TBFM **shall (SSD83)** provide textual and graphical command and response interface for user input.

3.2.3.1.4 TBFM **shall (SSD84)** display traffic flow definition information associated with the MRE.

3.2.3.1.5 TBFM **shall (SSD85)** display the status for a flight in relation to the applicable traffic flow definitions.

3.2.3.1.6 TBFM **shall (SSD86)** display the metering status of the MRE.

3.2.3.1.7 TBFM **shall (SSD87)** display current and scheduled airport status information.

3.2.3.1.8 TBFM **shall (SSD88)** display weather information on a planview as selected by user input.

3.2.3.1.9 TBFM **shall (SSD89)** be capable of displaying M&C information in graphical and textual format.

3.2.3.1.10 TBFM **shall (SSD90)** be capable of displaying the aircraft situational data on a planview.

3.2.3.1.11 TBFM **shall (SSD91)** be capable of displaying unique symbols for each aircraft type.

3.2.3.1.12 TBFM **shall (SSD92)** accept user requests to query flights by any flight data element and display all results matching the query criteria.

3.2.3.1.13 TBFM **shall (SSD93)** notify the user both visually and audibly when changes to the flight status occur during the APREQ process.

3.2.3.1.14 TBFM **shall (SSD94)** maintain, store and update displays based on user input and relevant information changes.

3.2.3.1.15 TBFM **shall (SSD95)** be capable of toggling between display views based on user input.

3.2.3.1.16 TBFM **shall (SSD96)** be capable of displaying combinations of windows based on user input.

3.2.3.1.17 TBFM windows **shall (SSD97)** be resizable and movable based on user input.

3.2.3.1.18 TBFM **shall (SSD98)** be capable of sending scheduling information for display on En Route sector controllers' displays at local and adjacent facilities.

3.2.3.1.19 TBFM **shall (SSD99)** provide electronic access to manuals (e.g., technical manuals and other job aids).

3.2.3.2 Statistical Calculations

3.2.3.2.1 TBFM **shall (SSD100)** accept user requests to display the computed traffic count and statistical delay information.

3.2.3.3 Display Control Limits

3.2.3.3.1 TBFM **shall (SSD101)** permit, on a display by display basis, the user allowable commands to be adaptable.

3.2.4 Print

3.2.4.1 TBFM **shall (SSD102)** print a copy of selected window.

3.2.4.2 TBFM **shall (SSD103)** print a copy of the current display.

3.2.5 Monitor and Control

3.2.5.1 Monitor and Control Functionality

3.2.5.1.1 TBFM **shall (SSD104)** monitor its hardware, software and interfaces for events while concurrently performing continuous operations.

3.2.5.1.2 TBFM **shall (SSD105)** be capable of monitoring Simple Network Management Protocol (SNMP)-based automation components.

3.2.5.1.3 TBFM **shall (SSD106)** provide its current configurations, including hardware and software identification, to the M&C function.

3.2.5.1.4 TBFM **shall (SSD107)** provide monitoring and controlling capability for remote facilities.

3.2.5.1.5 TBFM **shall (SSD108)** provide monitoring and status notification of specified NAS components and interfaces.

3.2.5.1.6 TBFM **shall (SSD109)** generate visual and audible indication of alarms, alerts, and status changes.

3.2.5.1.7 TBFM **shall (SSD110)** monitor the data required to determine when an event has occurred.

3.2.5.1.8 TBFM **shall (SSD111)** monitor the status of the management agent process of the system.

3.2.5.1.9 TBFM **shall (SSD112)** monitor the status of communication between the system and the M&C function.

3.2.5.1.10 TBFM **shall (SSD113)** monitor for changes in the configuration of the system.

3.2.5.1.11 TBFM **shall (SSD114)** monitor the logical configuration of system resources

3.2.5.1.12 TBFM **shall (SSD115)** monitor the physical configuration of system resources.

3.2.5.1.13 TBFM **shall (SSD116)** enable the M&C function to modify monitoring parameter thresholds.

3.2.5.1.14 TBFM **shall (SSD117)** be capable of starting, stopping, restarting and initiating recovery of system components.

3.2.5.1.15 TBFM **shall (SSD118)** display the current system and configuration status.

3.2.5.1.16 TBFM **shall (SSD119)** display an indication of each event notification.

3.2.5.1.17 TBFM **shall (SSD120)** display results of diagnostics.

3.2.5.1.18 TBFM **shall (SSD121)** display monitored parameters.

3.2.5.1.19 TBFM **shall (SSD122)** provide an internal diagnostic capability for fault isolation.

3.2.5.1.20 TBFM **shall (SSD123)** provide for manual isolation of components down to the Lowest Replaceable Units (LRU).

3.2.5.1.21 TBFM **shall (SSD124)** diagnose failed or degraded components to the Lowest Replaceable Unit (LRU) level.

3.2.5.1.22 TBFM system configuration **shall (SSD125)** not be included in the M&C function.

3.2.5.2 Maintenance of System Log

3.2.5.2.1 TBFM **shall (SSD126)** record system alarms, alerts, function errors, software component status, system status changes, and manually entered system configuration changes in a system log.

3.2.5.2.2 TBFM **shall (SSD127)** retain the system log for a minimum of 48 hours.

3.2.5.2.3 TBFM **shall (SSD128)** accept user request to display and print the system log.

3.2.6 Component Fail-Over

3.2.6.1 TBFM **shall (SSD129)** be capable of logically isolating and failing-over failed redundant system components.

3.2.7 Playback

3.2.7.1 TBFM **shall (SSD130)** have the capability to playback all previously recorded operating information without impacting operational system.

3.2.7.2 TBFM **shall (SSD131)** provide the capability to add simulated aircraft during playback.

3.2.7.3 TBFM **shall (SSD132)** provide the capability to exercise all of the functions of the operational TBFM during playback.

3.2.8 Simulation

3.2.8.1 TBFM **shall (SSD133)** have a simulation capability from which to exercise the system in a Government-approved laboratory environment.

3.2.9 Support Subsystem

3.2.9.1 Support Subsystem Functionality

3.2.9.1.1 TBFM **shall (SSD134)** have an on-site support subsystem capability that is capable of operating on a live one-way data feed from all external interfaces.

3.2.9.1.2 The TBFM support subsystem **shall (SSD135)** provide all functional capabilities of the operational system.

3.2.9.1.3 TBFM **shall (SSD136)** be capable of operating the support subsystem concurrently with the operational system with no adverse impact to the operational system.

3.2.9.1.4 TBFM support subsystem **shall (SSD137)** be capable of validating new software and site-specific adaptation releases.

3.2.9.1.5 TBFM support subsystem **shall (SSD138)** be capable of electronic transfer of software and adaptation from the support subsystem to the operational system.

3.2.9.1.6 TBFM support subsystem **shall (SSD139)** be capable of interfacing with the En Route training simulation system.

3.2.9.1.7 TBFM **shall (SSD140)** be capable of operating the support subsystem concurrently with the En Route training simulation system with no adverse impact to the En Route training simulation system.

3.2.9.2 Training

3.2.9.2.1 TBFM **shall (SSD141)** provide a system-based familiarization / training mode that supports Users, Maintenance, and Support input and interaction.

Note: TBFM training will emphasize operational functionality and usability of tools, including local scenario generation.

3.2.9.2.2 The TBFM training function **shall (SSD142)** include data recording, archiving, simulation, stop and restart, and playback capabilities.

3.2.9.2.3 TBFM **shall (SSD143)** provide an environment to support realistic training scenarios.

3.2.9.2.4 TBFM **shall (SSD144)** have the capability to use recorded operational data in training scenarios.

3.2.9.2.5 TBFM **shall (SSD145)** have the capability to create customized training scenarios.

3.2.9.2.6 TBFM **shall (SSD146)** provide a training capability to restore services, test, operate, manage, monitor, control, diagnose, analyze, and maintain the TBFM system and subsystems.

3.2.10 Engineering Support Subsystem

3.2.10.1 TBFM **shall (SSD147)** have an on-site engineering support subsystem capability that is capable of operating on a live one-way data feed from all external interfaces.

3.2.10.2 The TBFM engineering support subsystem **shall (SSD148)** provide all functional capabilities of the operational system.

3.2.10.3 TBFM **shall (SSD149)** be capable of operating the engineering support subsystem concurrently with the operational system with no adverse impact to the operational system.

3.3 System Interfaces

3.3.1 TBFM **shall (SSD150)** interface with NAS users and systems to accept and/or exchange weather information, flight information, schedule information, and Traffic Management Initiatives (TMI) from approved FAA En Route Automation, Terminal Automation, Traffic Flow Automation, and Weather sources.

3.3.2 TBFM **shall (SSD151)** exchange information with interfacing TBFM systems in accordance with FAA Data Standard for the NAS.

3.3.3 TBFM **shall (SSD152)** have the capability to filter TBFM data prior to distribution.

3.3.4 TBFM **shall (SSD153)** comply with FAA SWIM Standards, the SWIM Service Specification Document, and the SWIM Governance Policies Document

3.3.5 TBFM **shall (SSD154)** utilize the SWIM Service Registry to catalog and publish services.

3.3.6 TBFM **shall (SSD155)** receive digital coded time messages distributed from the CTS in accordance with Coded Time Source/User System (CTS/User System) Interface Control Document, NAS-IR-9202000, Section 3.2.1 Application Process Description.

3.4 TBFM Adaptation

3.4.1 TBFM **shall (SSD156)** be adaptable to facility airspace, procedures, aircraft, flight and scheduler information.

3.4.2 TBFM **shall (SSD157)** perform format, logic, and range checks to ensure that adaptation inconsistencies are identified.

3.4.3 TBFM **shall (SSD158)** provide support capabilities for the installation of new adaptation information at each facility.

3.4.4 TBFM **shall (SSD159)** provide the capability to modify adaptation for TBFM use in non-operational and operational modes.

3.4.5 TBFM **shall (SSD160)** provide the capability to access, validate, and test adaptation information.

3.4.6 TBFM **shall (SSD161)** provide the capability to fallback to previous adaptation information.

3.4.7 TBFM **shall (SSD162)** provide the capability to resolve adaptation inconsistencies.

3.4.8 TBFM **shall (SSD163)** automatically report overlaps and gaps when boundary data is processed.

3.4.9 TBFM **shall (SSD164)** provide confirmation of changes to the airspace structure or design prior to activation.

3.4.10 TBFM **shall (SSD165)** store and use adaptation information to generate reports.

3.4.11 TBFM **shall (SSD166)** provide a report to the user that details adaptation inconsistencies, errors, and unknown information encountered.

3.4.12 TBFM **shall (SSD167)** process and provide adaptation information to other systems.

3.5 Design and Construction

3.5.1 Accessibility

3.5.1.1 All system equipment **shall (SSD168)** meet the accessibility requirements of FAA-G-2100.

3.5.1.2 The design of the equipment and equipment racks **shall (SSD169)** provide front or rear access or both, as needed to support maintenance or repair activities.

3.5.1.3 All system equipment **shall (SSD170)** be maintainable by a work force with anthropometric and bio-mechanic characteristics in accordance with FAA Human Factors Design Standard (HFDS).

3.5.1.4 No removable component **shall (SSD171)** weigh more than the maximum limits allowed for objects lifted by one person using both hands in accordance with the FAA HFDS.

3.5.1.5 Where mismating of connectors could cause physical or electrical damage, positive means **shall (SSD172)** be provided to prevent the inadvertent reversing or mismating of fittings, couplings, mechanical linkage, instrument leads, or electrical connections in accordance with FAA –G-2100H.

3.5.1.6 Handles or suitable grasping mechanisms **shall (SSD173)** be provided for equipment units that require lifting, removal, carrying or handling in accordance with the FAA HFDS.

3.5.2 Structural and Seismic Stability

3.5.2.1 All system equipment **shall (SSD174)** meet the structual and seismic requirements of FAA-G-2100.

3.5.3 Operational Design Considerations

3.5.3.1 Energy Conservation

3.5.3.1.1 TBFM **shall (SSD175)** meet the energy conservation requirements of the National Energy Conservation Policy Act as referenced in Executive Order 12902, Energy Efficiency and Water Conservation At Federal Facilities, The Energy Policy Act of 1992.

3.5.3.2 Acoustic Noise

3.5.3.2.1 The aggregate noise level for the system equipment procured for use in operational areas, measured at a distance not greater than three (3) feet, **shall (SSD176)** be less than or equal to 55dbA and in accordance with the FAA HFDS and FAA-G-2100.

3.5.3.2.2 The aggregate noise level for the system equipment procured for use in equipment areas, measured at a distance not greater than three (3) feet, **shall (SSD177)** be less than or equal to 65dbA and in accordance with the FAA HFDS and FAA-G-2100.

3.5.3.3 Operating Environment

3.5.3.3.1 The TBFM operating environmental limits **shall (SSD178)** be in accordance with FAA-G-2100.

3.5.3.3.2 The environmental limits that are specified for the steady state **shall (SSD179)** apply to both forced air and ambient air cooled systems.

3.5.3.3.3 Equipment that requires forced air cooling **shall (SSD180)** operate using under-floor, positive-pressure at a nominal 0.02-0.05 inches of water.

3.5.3.4 Non-Operating Environment

3.5.3.4.1 The TBFM non-operating environmental limits **shall (SSD181)** be in accordance with FAA-G-2100.

3.5.4 Heating, Ventilation, Air Conditioning

3.5.4.1 TBFM hardware **shall (SSD182)** meet manufacturer specifications for heating, ventilation, and air conditioning.

3.5.4.2 The temperature within TBFM cabinets **shall (SSD183)** not exceed the thermal specifications of any component within.

3.5.4.3 TBFM cabinets using forced air ventilation **shall (SSD184)** contain its own blower system.

3.5.4.4 TBFM cabinets using forced air ventilation **shall (SSD185)** require no external ducts.

3.5.4.5 The equipment **shall (SSD186)** operate continuously without malfunctioning for up to eight (8) consecutive hours with the access doors open, cover plates removed and drawers extended for servicing.

3.5.4.6 Exhaust **shall (SSD187)** be through openings located at the top of the equipment cabinets.

3.5.4.7 Cabinets **shall (SSD188)** be designed so that equipment exhaust presents no safety hazards to personnel.

3.5.5 Grounding, Bonding, Shielding, and Lightning Protection

3.5.5.1 TBFM **shall (SSD189)** meet all necessary FAA-STD-019E Lightning Protection, Grounding, Bonding, and Shielding for Facilities.

3.5.5.2 TBFM grounding **shall (SSD190)** be in accordance with Section 3.80F FAA-STD-019E.
Note: The government will furnish the multi-point ground system at all sites and the AC power ground at all sites.

3.5.5.3 TBFM **shall (SSD191)** be designed to avoid ground loops and shared impedance-coupling paths.

3.5.5.4 TBFM **shall (SSD192)** use a common ground derived from the AC power source for all AC power in the system.

3.5.5.5 TBFM shall (SSD193) have a common ground potential for all surfaces of front panels, chassis, frames and cabinets.

3.5.6 Cables

3.5.6.1 Cables and cable routing systems **shall (SSD194)** comply with the NFPA 70, FAA-C-1217F, *U.S. DOT FAA Specification Electrical Work, Interior* and applicable Institute of Electrical and Electronics Engineers (IEEE)/American National Standards Institute (ANSI) standards.

3.5.6.2 All cables **shall (SSD195)** be tested for compliance with FAA Order 6950.22.

3.5.6.3 Cabinet/frame cabling and wiring **shall (SSD196)** comply with FAA-G-2100, the NFPA 70 and FAA-C-1217F and FAA Order 6470.33.

3.5.6.4 Cable access **shall (SSD197)** be through the bottom of the cabinet or frame via the raised floor plenum.

3.5.6.5 System equipment, frames, cabinets, enclosures and transition racks **shall (SSD198)** contain mechanical provisions for cable strain relief in compliance with FAA-G-2100.

3.5.6.6 All cabinet/frame cabling **shall (SSD199)** permit accessibility to equipment for test, maintenance and replacement.

3.5.7 Hazardous Materials

3.5.7.1 All hazardous materials **shall (SSD200)** be identified and comply with FAA specification for control and disposal.

3.5.7.2 All hazardous materials **shall (SSD201)** be accompanied by manufacturer's material safety data sheet.

3.5.8 Power Systems and Commercial Power

3.5.8.1 Facility Power

3.5.8.1.1 The operational components of TBFM **shall (SSD202)** use facility power compliant with a critical system.

3.5.8.2 Load Balancing

3.5.8.2.1 TBFM electrical load **shall (SSD203)** be balanced during equipment installation in accordance with FAA-G-2100.

3.5.8.2.2 TBFM system loads **shall (SSD204)** be distributed among the government designated power panels to achieve load balance and power redundancy, as approved by the FAA.

3.5.8.2.3 TBFM electrical power measurements **shall (SSD205)** be in accordance with FAA-G-2100.

3.5.8.3 Power Quality

3.5.8.3.1 TBFM's limits for inrush current, for over current and duration, **shall (SSD206)** comply with FAA-G-2100.

3.5.8.3.2 The power voltage tolerances for developed and commercial equipment **shall (SSD207)** be in accordance with FAA-G-2100.

3.5.8.3.3 The power factor for Commercial Off The Shelf (COTS) and developed equipment **shall (SSD208)** be .6 lag to .7 lead in accordance with FAA-G-2100.

3.5.8.3.4 All equipment including the aggregate of multiple hardware items combined on a single power circuit **shall (SSD209)** not exceed the limits listed in FAA-G-2100, as measured at the input side of the power panel.

3.5.8.3.5 For developed hardware, electrical overload protection **shall (SSD210)** be in accordance with FAA-G-2100.

3.5.8.4 Power Switches/Breakers

3.5.8.4.1 All power switches and breakers **shall (SSD211)** meet the requirements of the NFPA 70 and UL-1950 and FAA-G-2100.

3.5.8.4.2 Switches/breakers **shall (SSD212)** be listed by an OSHA approved testing laboratory.

3.5.8.5 Rack Power

3.5.8.5.1 All COTS and developed equipment **shall (SSD213)** be designed to operate on 120/208V AC, 60 Hz, and single-phase 3-wire or 3-phase 4-wire power.

3.5.8.5.2 All rack assembly equipment **shall (SSD214)** operate from two separate 60 Hz power sources when redundant hardware devices are contained in the rack or one 60Hz power source when non-redundant hardware devices are contained in the rack.

3.5.8.5.3 AC convenience outlets, separate from the equipment critical power source, **shall (SSD215)** be provided for all cabinets and frames in accordance with FAA-G-2100

3.5.8.5.4 System equipment and critical power cable connectors **shall (SSD216)** be mechanically retained in place.

3.5.9 Electromagnetic Interference (EMI) / Electromagnetic Compatibility (EMC)

3.5.9.1 General

3.5.9.1.1 All commercial equipment **shall (SSD217)** meet the electromagnetic compatibility requirements of the FAA-G-2100 and the Federal Communications Commission (FCC) Class A, (47 CFR Part 15).

3.5.9.1.2 All developed hardware **shall (SSD218)** meet the requirements specified in FAA-G-2100, and MIL-STD-461E paragraph 5.3, as they relate to hardware emissions and susceptibility.

3.5.9.2 EMI Emissions

3.5.9.2.1 TBFM, whether standalone or in racks, **shall (SSD219)** not degrade other NAS equipment.

3.5.9.2.2 All developed equipment **shall (SSD220)** meet the radiated emission limits of MIL-STD-461E.

3.5.9.3 EMI Susceptibility

3.5.9.3.1 TBFM, whether standalone or in racks, whether commercial or developed, **shall (SSD221)** not be degraded by other NAS equipment.

3.5.9.3.2 All developed equipment **shall (SSD222)** meet the conducted susceptibility requirements of MIL-STD-461E.

3.5.10 Special Considerations

3.5.10.1 Equipment Workmanship

3.5.10.1.1 TBFM **shall (SSD223)** meet the workmanship standards of MIL-HDBK-454 or a contractor workmanship standard deemed acceptable by the Government.

3.5.10.2 Finish

3.5.10.2.1 Exposed surfaces of TBFM equipment **shall (SSD224)** have painted finishes in accordance with FAA-STD-001.

3.5.10.2.2 Exposed surfaces **shall (SSD225)** be finished to resist wear and scuffing.

3.5.10.2.3 Equipment surface textures **shall (SSD226)** be easily cleaned.

3.5.10.2.4 All surfaces **shall (SSD227)** be free of rough, ragged, or sharp protrusions.

3.5.10.3 Cabinet and Frame Design Construction

3.5.10.3.1 The maximum dimensions of the room cabinets and frames **shall (SSD228)** be: height of 79 inches (2.01 meters) above the raised floor; width of 49.5 inches (1.26 meters); depth of 37.125 inches (0.94 meters).

3.5.10.3.2 The loading conditions of each fully equipped cabinet and frame **shall (SSD229)** not exceed 125 pounds per square foot.

3.5.10.3.3 The structural strength and rigidity of the cabinets and frames **shall (SSD230)** be such that normal handling in loading, shipping, unloading and setting into position during installation will not result in any damage to the equipment housed within the cabinet.

3.5.10.3.4 No deformation to the cabinets or frames **shall (SSD231)** occur as the result of removal or interchanging of equipment or modules.

3.5.10.3.5 Cabinets or frames **shall (SSD232)** meet structural strength and rigidity requirements without contributory affects of access doors.

3.5.10.4 Labeling

3.5.10.4.1 All cable connectors furnished on the equipment for making external connections **shall (SSD233)** be clearly identified on the plug-in side by word labels descriptive of their specific function and by the proper reference designation in accordance with FAA-G-2100.

3.5.10.4.2 Equipment labeling and redundant subsystem hardware configurations **shall (SSD234)** meet the requirements of the FAA HFDS-001.

3.5.10.4.3 Safety labeling **shall (SSD235)** meet the requirements of the FAA HFDS-001.

3.5.11 Computer Resource Requirements

3.5.11.1 TBFM **shall (SSD236)** be composed of hardware configuration items, software configuration items and database configuration items, selected based upon intended use, support, maintenance, and configuration control.

3.5.11.1 Computer Hardware

3.5.11.1.1 TBFM **shall (SSD237)** be comprised of COTS hardware

3.5.11.1.2 TBFM design **shall (SSD238)** be scalable and modular while providing for expandability.

3.5.11.1.3 The overall dimensions of the TBFM hardware **shall (SSD239)** not exceed the dimensions of the current TMA hardware.

3.5.11.1.4 The TBFM hardware **shall (SSD240)** be capable of being mounted within the existing TMA equipment racks.

3.5.11.1.5 TBFM system hardware **shall (SSD241)** be supportable through CY 2016.

3.5.11.1.6 TBFM system hardware replacement parts **shall (SSD242)** be available through CY 2016.

3.5.11.2 Computer Hardware Resource Utilization Requirements

3.5.11.2.1 TBFM **shall (SSD243)** provide flexible processing and memory capacity to ensure a minimum of 15% reserve capacity during peak operating loads.

3.5.11.3 Computer Software

3.5.11.3.1 TBFM **shall (SSD244)** be compatible with the existing and new hardware and operating system.

3.5.11.3.2 TBFM **shall (SSD245)** utilize a COTS open source computer operating system

3.5.11.3.3 The TBFM operating system **shall (SSD246)** conform to the POSIX standard (IEEE 1003.1, Portable Operating System Interface Part 1 Library Routines, System Calls and Header files) and be compliant with the SVID3, System V Interface Definition, Third Edition.

3.5.11.3.4 The operating system **shall (SSD247)** be capable of running the compiled TBFM code base.

3.6 Human System Integration

3.6.1 Human System Integration Standards

3.6.1.1 TBFM **shall (SSD248)** be designed, developed and tested in accordance with the DOT/FAA/CT-96/1 Human Factors Design Standard (HFDS) and MIL-HDBK-46885 Human Engineering Program Process and Procedures.

3.6.2 Human-Centered Design

3.6.2.1 Usability

3.6.2.1.1 TBFM human-system ease of use **shall (SSD249)** be in accordance with the FAA HFDS.

3.6.2.2 Operational Suitability

3.6.2.2.1 TBFM human-to-system interfaces **shall (SSD250)** be compatible and consistent within and across system and NAS elements in accordance with the FAA HFDS.

3.6.2.3 Functional Allocation

3.6.2.3.1 TBFM system function assignment to users **shall (SSD251)** be in accordance with the FAA HFDS.

3.6.2.4 Human Capabilities and Limitations

3.6.2.4.1 The TBFM system displays and user commands and controls **shall (SSD252)** be compatible with user perceptual and cognitive capabilities and limitations in accordance with the FAA HFDS.

3.6.3 Human to System Interfaces

3.6.3.1 Design Simplicity

3.6.3.1.1 The TBFM system or equipment design **shall (SSD253)** be designed for simplicity of use, consistent with the desired human-machine system functions, and compatible with the expected maintenance and operational concepts in accordance with the FAA HFDS.

3.6.3.1.2 TBFM **shall (SSD254)** provide a consistent, common Computer Human Interface (CHI), including display symbols, icons, graphics, alphanumeric format, fonts, color usage, and other characteristics across all displays.

3.6.3.1.3 The TBFM system **shall (SSD255)** be designed to be consistent, behaving, and responding the same across all displays.

3.6.3.2 Identical Functions

3.6.3.2.1 TBFM system equipment with identical functions **shall (SSD256)** employ identical or highly similar human-system interfaces, including hardware and software tools, in accordance with FAA HFDS.

3.6.3.3 Situational Awareness

3.6.3.3.1 TBFM system information displays **shall (SSD257)** meet situational awareness requirements in accordance with the FAA HFDS.

3.6.4 Computer Human Interface (CHI) Requirements

3.6.4.1 Screen Design

3.6.4.1.1 The TBFM system screen designs and color coding **shall (SSD258)** be in accordance with the FAA HFDS.
Screen layouts, menus, icons, and transaction sequences **shall (SSD259)** be logically arranged to support user task performance.

3.6.4.1.2 User-selected objects in a display **shall (SSD260)** be highlighted.

3.6.4.1.3 A title **shall (SSD261)** be displayed at the top of every screen that is separate and distinguishable from the body of the screen and that describes briefly the contents or purpose of the screen.

3.6.4.1.4 The display of critical information **shall (SSD262)** not be blocked, overlaid, obstructed, or disappear from the screen without a positive action by the user.

3.6.4.1.5 TBFM **shall (SSD263)** maintain display preference information.

3.6.4.2 Menu Design

3.6.4.2.1 The design and use of menus **shall (SSD264)** be consistent, avoiding complex hierarchies and graphical structures that hinder comprehension and navigation.

3.6.4.2.2 Menu options **shall (SSD265)** be ordered and grouped logically, based on task sequence or frequency of use.

3.6.4.2.3 When menu selection is used in conjunction with command language interaction, wording of menu options **shall (SSD266)** be consistent with the command language.

3.6.4.3 Audio Signal Coding

3.6.4.3.1 Audio warning signals **shall (SSD267)** be discrete and distinguishable from each other.

3.6.4.3.2 Audio warning signals **shall (SSD268)** be user selectable.

3.6.4.3.3 Redundant visual coding **shall (SSD269)** be used with audio alarms.

3.6.4.4 Alerts

3.6.4.4.1 TBFM **shall (SSD270)** display an alert for specified non-critical events.

3.6.4.4.2 TBFM **shall (SSD271)** display an informational message for a state change.

3.6.4.4.3 TBFM **shall (SSD272)** provide the status of alert and alarm filtering on request.

3.6.4.4.4 Alerts **shall (SSD273)** be visually distinguishable from other text.

3.6.4.5 Audible Alarms

3.6.4.5.1 TBFM **shall (SSD274)** provide the capability to configure audible alarms at the display.

3.6.4.6 User Interaction

3.6.4.6.1 TBFM **shall (SSD275)** support the configuration of hot button and quick action keys.

3.6.4.6.2 For displays, design of system commands and access methods **shall (SSD276)** comply with the FAA HFDS and applicable design standards for the operating system.

3.6.4.6.3 TBFM **shall (SSD277)** provide a method of data input that allows the user to complete a command from a single input source.

3.6.4.6.4 TBFM **shall (SSD278)** allow the user to create and save and execute a sequence of commands.

3.6.4.6.5 TBFM **shall (SSD279)** allow the user to edit and cancel a command during composition.

3.6.4.6.6 TBFM **shall (SSD280)** minimize data entry and require the users to enter data once to complete a given function.

3.6.4.7 Input Feedback

3.6.4.7.1 TBFM **shall (SSD281)** display an error message in response to user commands that fail checks of format, logic, and range.

3.6.4.7.2 TBFM **shall (SSD282)** display response/feedback notifications on the same display that was used to create the input.

3.6.4.7.3 TBFM **shall (SSD283)** provide error messages in plain language that identify the error and its effect, and suggest corrective action.

3.6.4.7.4 TBFM **shall (SSD284)** display a warning message before executing potentially destructive or disruptive actions.

3.6.4.7.5 When TBFM does not recognize an element of a command entry, TBFM **shall (SSD285)** prompt the user to correct that element rather than require reentry of the entire command.

3.6.4.8 Notifications

3.6.4.8.1 TBFM **shall (SSD286)** report an event when a specified parameter exceeds a threshold.

3.6.4.8.2 TBFM **shall (SSD287)** sum repeated event occurrences and report a single event to avoid event report flooding.

3.6.4.8.3 TBFM **shall (SSD288)** report a return-to-normal event when a specified parameter falls below the reporting threshold by a specified margin.

3.6.4.9 On-Line Help

3.6.4.9.1 TBFM **shall (SSD289)** provide and display an on-line context-sensitive HELP function.

3.6.5 Displays and Controls

3.6.5.1 Screen brightness and contrast ratio **shall (SSD290)** be controllable features of the display.

3.6.5.2 TBFM **shall (SSD291)** provide a range of font sizes which are user selectable.

3.6.5.3 TBFM **shall (SSD292)** provide font sizes that are large enough so displays are readable from the position from which they will normally be used.

3.6.6 Maintainability

3.6.6.1 The TBFM Maintainer-to-system interfaces **shall (SSD293)** be in accordance with the FAA HFDS.

3.7 Security and Privacy Requirements

3.7.1 The Commercial Off-the-Shelf (COTS) software used in the TBFM system **shall (SSD294)** meet the C2 criteria of DoD 5200.28-STD, Trusted Computer System Evaluation Criteria.

3.7.2 TBFM **shall (SSD295)** comply with FAA Order 1370.82A (Information Systems Security Program).

3.7.3 TBFM **shall (SSD296)** be capable of uniquely identifying and authenticating users.

3.7.4 TBFM **shall (SSD297)** display an FAA “Logon Warning Banner” at logon as specified in FAA Order 1370.102.

3.7.5 TBFM **shall (SSD298)** be capable of assigning a unique identifier to each authenticated user.

3.7.6 TBFM **shall (SSD299)** be capable of assigning a unique identifier to each subsystem process, including those not running on behalf of a human user.

3.7.7 TBFM **shall (SSD300)** be capable of managing and protecting security data and mechanisms.

3.7.8 TBFM **shall (SSD301)** be capable of enabling access control, authentication, and authorization management for each user.

3.7.9 TBFM **shall (SSD302)** be capable of auditing in support of individual accountability and detection of and response to security breach.

3.7.10 TBFM **shall (SSD303)** provide mechanisms for detecting and logging security breaches and unauthorized access attempts.

3.7.11 TBFM **shall (SSD304)** protect audit logs against deletion and modification.

3.7.12 TBFM **shall (SSD305)** be capable of detecting and removing malicious code and data (e.g., viruses and worms) upon request.

3.7.13 TBFM **shall (SSD306)** automatically suspend user accounts after three failed logon attempts.

3.7.14 TBFM **shall (SSD307)** automatically force a user logoff after an adaptable number of minutes of inactivity and send an alert message to the administrator.

3.7.15 TBFM **shall (SSD308)** be capable of performing a secure self test.

3.7.16 TBFM **shall (SSD309)** protect system software code against unauthorized deletion and modification.

3.7.17 TBFM **shall (SSD310)** perform a self test at each start-up to verify the unmodified presence of all system security function hardware and software components.

3.7.18 If TBFM has detected the absence or modification of a system security function hardware or software component, TBFM **shall (SSD311)** alarm and halt start-up until released by the Security Administrator.

3.7.19 TBFM **shall (SSD312)** enforce separation of duties through assigned access authorizations.

3.7.20 TBFM **shall (SSD313)** automatically disable inactive accounts in accordance with the organization-defined time period.

3.7.21 TBFM **shall (SSD314)** employ automated mechanisms to audit account creation, modification, disabling, and termination actions and to notify, as required, appropriate individuals.

3.7.22 TBFM **shall (SSD315)** produce audit records that contain sufficient information to establish what events occurred, the sources of the events, and the outcome of the events.

3.7.23 TBFM **shall (SSD316)** alert appropriate organizational officials in the event of an audit processing failure and take additional actions defined by the organization (e.g. shut down information system, overwrite oldest audit records, stop generating audit records).

3.7.24 TBFM **shall (SSD317)** provide an audit reduction and report generation capability.

3.7.25 TBFM **shall (SSD318)** provide the capability to automatically process audit records for events of interest based on selectable event criteria.

3.7.26 TBFM **shall (SSD319)** provide time stamps for use in audit record generation.

3.7.27 TBFM **shall (SSD320)** employ multi-factor authentication for remote system access that is compliant with NIST Special Publication 800-63.

3.7.28 TBFM **shall (SSD321)** prevent unauthorized and unintended information transfer via shared system resources.

3.7.29 TBFM **shall (SSD322)** protect against denial-of-service attacks.

3.7.30 TBFM **shall (SSD323)** monitor and control communications at the external boundary of the information system and at key internal boundaries within the system.

3.7.31 TBFM **shall (SSD324)** deny network traffic by default and allow network traffic by exception (i.e. deny all, permit by exception).

3.7.32 TBFM **shall (SSD325)** protect the integrity of transmitted information.

3.7.33 TBFM **shall (SSD326)** protect the confidentiality of transmitted information.

3.7.34 TBFM **shall (SSD327)** terminate a network connection at the end of a session or after the organization-defined time period of inactivity.

3.7.35 TBFM **shall (SSD328)** prohibit remote activation of collaborative computing mechanisms and provide an explicit indication of use to the local users.

3.7.36 TBFM **shall (SSD329)** provide mechanisms to protect the authenticity of communications sessions.

3.7.37 TBFM **shall (SSD330)** automatically update malicious code protection mechanisms.

3.7.38 TBFM **shall (SSD331)** monitor inbound and outbound communications for unusual or unauthorized activities or conditions.

3.7.39 TBFM **shall (SSD332)** provide a real-time alert when the organization-defined indications of compromise or potential compromise occur.

3.7.40 TBFM **shall (SSD333)** implement spam protection.

3.7.41 TBFM **shall (SSD334)** check information for accuracy, completeness, validity, and authenticity.

3.7.42 TBFM **shall (SSD335)** identify and handle error conditions in an expeditious manner without providing information that could be exploited by adversaries.

3.7.43 TBFM **shall (SSD336)** be located in a facility with controlled access, in accordance with site security plans and FAA Order 1600.69, FAA Facility Security Management Program.

3.7.44 TBFM security **shall (SSD337)** be applied throughout the service life of the system.

3.7.45 Personnel security controls **shall (SSD338)** be implemented in accordance with FAA Order 1600.1D, Personnel Security Program.

3.7.46 TBFM system security **shall (SSD339)** be certified and approved in accordance with FAA Order 1370.82A, Information System Security Program.

3.7.47 TBFM **shall (SSD340)** be developed and maintained in accordance with FAA Order 1370.91 Information System Security Patch Management.

3.7.48 TBFM **shall (SSD341)** ensure information integrity, availability, and confidentiality.

3.7.49 TBFM availability **shall (SSD342)** be in accordance with the Reliability, Maintainability, and Availability (RMA) standards set for NAS essential systems as defined by NAS-SR-1000 Functional View and FAA Order 6000.53 Remote Maintenance Monitoring Interfaces.

3.7.50 TBFM **shall (SSD343)** comply with Federal Information Processing Standards (FIPS) 199: Standards for Security Categorization of Federal Information and Information Systems.

3.7.51 TBFM **shall (SSD344)** ensure that security functions recover to a consistent and secure state.

3.8 Performance Requirements

This section specifies the response time, resource utilization, reliability, maintainability, availability, flexibility, and reusability requirements for the TBFM operational system. The operational system includes all hardware and software resources supporting TBFM services plus any additional hardware and software within the system boundary supporting systems operations. All requirements in this section apply to the operational TBFM systems at all facilities. These requirements do not apply to other support systems.

3.8.1 System Performance

3.8.1.1 When a portion of TBFM functionality is not working, is unavailable, or is in a degraded mode, the remaining TBFM functionality **shall (SSD345)** continue to operate.

3.8.1.2 TBFM **shall (SSD346)** be designed so that system operations do not degrade any of the following properties of any interfacing system or element: response times, peak throughput, accuracy, reliability, maintainability, or availability.

3.8.1.3 TBFM **shall (SSD347)** be capable of supporting multiple workstation displays without any measurable performance degradation.

3.8.1.4 TBFM **shall (SSD348)** maintain the precision of information exchanged with external sources.

3.8.1.5 TBFM **shall (SSD349)** perform format, logic, and range checks of information exchanged with external sources.

3.8.1.6 TBFM **shall (SSD350)** generate and display an error message if incoming information fails a format, logic, or range check.

3.8.1.7 TBFM **shall (SSD351)** generate and display error messages that identify the type and nature of information error.

3.8.1.8 TBFM **shall (SSD352)** process information at the refresh rate of the information source.

3.8.1.9 TBFM **shall (SSD353)** allow performance checks without impact on operational service and NAS system.

3.8.1.10 TBFM **shall (SSD354)** have an inherent availability of 0.999 and be in compliance with SR1000.

3.8.1.11 TBFM **shall (SSD355)** provide equipment mean-time-between-failure (MTBF) consistent with manufacturer's specification as approved by the Government.

3.8.1.12 TBFM **shall (SSD356)** provide mean-time-to-repair (MTTR) consistent with system hardware and software to be validated by the FAA during Factory Acceptance Test.

3.8.1.13 TBFM **shall (SSD357)** be designed to minimize the amount of required preventive maintenance.

3.8.1.14 TBFM **shall (SSD358)** be designed so that no single hardware failure causes loss of operational service to the user except for individual display system.

3.8.1.15 All newly developed equipment (if any) **shall (SSD359)** meet the design and maintainability requirements of MIL-STD-1472 unless otherwise specified.

3.8.1.16 TBFM **shall (SSD360)** provide a means to measure and report system performance.

3.9 Employee Safety and Health Requirements

3.9.1 TBFM **shall (SSD361)** comply with Executive Order 12196, Occupational Safety and Health Program for Federal Employees.

Note: This Order establishes and maintains occupational safety and health programs to meet requirements of PL 91-596, Section 19, Occupational Safety and Health Act.

3.9.2 TBFM **shall (SSD362)** comply with Title 29 CFR 1960, Safety and Health Provisions for Federal Employees.

3.9.3 TBFM **shall (SSD363)** comply with FAA Order 3900.19, Occupational Safety and Health Program.

Note: This Order states policy and provides the basic guidance for implementing the FAA Occupational Safety Program in full conformance with Executive Order 12196. In Chapter 3 paragraph 27 it addresses the correction of unsafe conditions and practices (abatement) and establishes the requirement for an abatement plan in the event that corrections cannot be accomplished within 30 working days.

3.9.4 TBFM **shall (SSD364)** comply with Occupational Safety and Health Administration (OSHA) safety requirements defined in FAA-G-2100 and the personnel safety requirements of 29 CFR 1910, *Occupational Safety and Health Standards* and the *National Fire Protection Association Standard 70 (NFPA 70), National Electrical Code*.

3.9.5 TBFM **shall (SSD365)** comply with radiation health hazard and protection requirements as defined in American National Standard Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE) C95.1.

3.9.6 TBFM **shall (SSD366)** be free of asbestos, polychlorinated biphenyls (PCBs), lead, and class one ozone-depleting substances, with the exception of mercury that may be present in the liquid crystal display (LCD) of computer monitors with quantities not to exceed 60 milligrams and lead that is used in the manufacture of computer circuit boards and monitors.

3.9.7 TBFM **shall (SSD367)** minimize the production of hazardous waste as defined in FAA-G-2100.

3.9.8 TBFM **shall (SSD368)** limit personnel exposure to hazardous materials to levels permitted by 29 CFR 1910, Subpart Z.

3.10 Quality

3.10.1 Quality Standards

3.10.1.1 TBFM **shall (SSD369)** be developed in accordance with ANSI/International Standards Organization (ISO)/American Society for Quality Control (ASQC) Q-900-2 Quality Management Systems.

3.10.2 Verification

3.10.2.1 TBFM **shall (SSD370)** be able to verify that all requirements identified in this document have been met either through demonstration, test, analysis, inspection or any special qualification methods approved by the Government.

Appendix A: Acronyms

AAR	Airport Acceptance Rate
ACM	Adjacent Center Metering
ANSI	American National Standards Institute
ATC	Air Traffic Control
ATCT	Airport Traffic Control Towers
ATO	Air Traffic Organization
ATCSCC	Air Traffic Control System Command Center
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
CHI	Computer Human Interface
COTS	Commercial Off The Shelf
DSR	Display System Replacement
EDC	Enhanced Departure Capability
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ERAM	En Route Automation Modernization
ETA	Estimated Time of Arrival
ETMS	Enhanced Traffic Management System
FAA	Federal Aviation Administration
FAALC	FAA Academy/Logistics Center
FAF	Final Approach Fix
FCFS	First-Come-First-Serve
FIPS	Federal Information Processing Standards
HFDS	Human Factors Design Standards
IEEE	Institute of Electrical and Electronics Engineers
IES	Integrated Enterprise System
ISS	Information System Security
ICAO	International Civil Aviation Organization
IDAC	Integrated Departure/Arrival Capability
LRU	Lowest Replaceable Unit
M&C	Monitor and Control
MF	Meter Fix
MIT	Miles in Trail
MINIT	Minutes in Trail
MNS	Mission Need Statement
MRE	Meter Reference Element
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NAS	National Airspace System
NFPA	National Fire Protection Association
NextGen	Next Generation Air Transportation System
OI	NextGen Operational Improvements (OIs)
PCB	Polychlorinated Bi-Phenols

RMM	Remote Maintenance Monitoring
RNAV/RNP	Area Navigation (RNAV) and Required Navigation Performance (RNP)
RUC	Rapid Update Cycle
SEM	System Engineering Manual
SID	Standard Instrument Departure
SNMP	Simple Network Management Protocol
SOA	Service Oriented Architecture
SSD	System Specification Document
STA	Scheduled Time of Arrival
STAR	Standard Terminal Arrival Rate
STARS	Standard Terminal Automation Replacement System
SWIM	System Wide Information Management
TBFM	Time Based Flow Management
TBM	Time Based Metering
TFM	Traffic Flow Management
TFMS	Traffic Flow Management System
TMA	Traffic Management Advisor
TMC	Traffic Management Coordinator
TMI	Traffic Management Initiative
TRACON	Terminal Radar Approach Control
UTC	Coordinated Universal Time
VNC	Virtual Network Computing
WJHTC	William J. Hughes Technical Center

Appendix B: Glossary

Adaptation: A collection of data files that customizes the functions of TBFM to a specific air traffic control facility.

Adaptation Information: Includes Airspace and Airport configuration.

Adapted Airport: An airport for which adaptation data files exist and schedules/advisories may be generated by TMA.

Airport Acceptance Rate: A dynamic input parameter specifying the number of arriving aircraft (measured at the runway threshold) which an airport or airspace can accept from the ARTCC per hour.

Airport Status Information: Includes AAR, runway status and configurations.

Aircraft information: Includes type of aircraft such as the model, engine type and performance characteristics.

Alarm: An alarm is defined as a condition that occurs when a subsystem determines that a key monitored parameter, condition, or status is outside required operating limits, or changed to an invalid state. When this happens, the subsystem shall be considered to be in an alarm condition.

Alert: An alert is defined as a condition that occurs when a subsystem determines that a key monitored parameter, condition or status is within required operating limits but outside desired operating limits. When this happens, the subsystem shall be considered to be in an alert state.

APREQ Process: Approval Required. ARTCC and TRACON TMC puts restriction on local departures, specifying that they must call for approval before releasing a flight into a congested airspace.

Authorization Management: The initialization, assignment, and modification of access rights (e.g. read, write, execute) to data objects with respect to (1) active entity name or group membership; and (2) such constraints as time-of-day and port-of-entry.

Closed Route: A closed route is a TMI which restricts flights from using a particular NAS resource while the TMI is in effect.

Configurable Parameters: Include arrival gates, MREs, arrival airports, runways at arrival airports, satellite airports, preferential arrival routes (PARs), center

airway routes for display, TRACON maps for display, ARTCC sector boundaries, TRACON boundaries, Special Use Airspace (SUA).

Conformance Priority Order: Defines the order of constraints under which aircraft will be sequenced for the default traffic flow definition.

Coordinated Schedule: Schedule calculated between linked MREs such that the ETA (and the STA) of the flight to the downstream MRE is based on the STA of the flight to the upstream MRE.

Critical System: Any air traffic control system that would make the job of maintaining adequate separation impossible if it failed.

Display Information: Information that will be included on TBFM displays. This includes timelines, planviews, flight information, aircraft information, traffic flow definition, destination airport, MRE, weather information, airborne and ground delays, ARTCC boundaries, TRACON boundaries, reports, graphs, and text.

Diversion List: List of flights that have been diverted to nearby airports that may represent future landing demand. The diversion list details diversion information for each diverted flight for each facility.

Eligible Flight: Flight with a new or amended active flight plan

Essential System: Any air traffic control system that would make the job of maintaining adequate separation more difficult if it failed.

Estimated Time of Arrival: ETA is the time at which the aircraft is estimated to cross the MRE (e.g. runway threshold, MRE, FAF). The ETA is determined without any restrictions imposed by other aircraft or airspace constraints. A non-radar based ETA is derived from an aircraft's flight plan. It is used until the aircraft is tracked by radar. A radar-based ETA is computed based on the aircraft's current position and velocity estimates given by the surveillance processor, the expected route, speed, altitude profile of the aircraft to the threshold, and the projected wind.

Estimated Time of Departure: The time at which the aircraft is estimated to take off.

Facility: Those locations at which TBFM equipment is located, including TRACONs, ARTCCs, Towers, WJHTC and the ATCSCC

Feeder Gate: A region in which arrival aircraft enter the TRACON. A feeder gate may contain one or more MREs. The typical TRACON has

four feeder gates, one each to the North East, North West, South East and South West of the airport

Flight Events: Include arrivals at destination airports, departures from originating airports, fix crossings, and entry to or exit from facility airspace.

Flight Information: Includes flight plan data (NAS/FAA/ICAO); aircraft location (lat/long); speed; heading; altitude; schedules (ETAs and STAs associated with each MRE); planned route data including SIDs, En Route, and STARs; updates; estimated time of departure data, flight and track messages, FCA index files, FEA definition files, FCATA flight lists, DZ messages, surface data, and NAS users' departure intent data.

Flight Information Updates: The system receives updated flight information upon receipt of the following messages: position update messages; arrival messages; departure messages; NAS airspace element crossing messages (e.g. NAVAID, FEA, sector crossing).

Graphical User Interface: Provides the computer-human interface (CHI) for the TMC. The GUI function is capable of generating a number of display presentations that can be provided at any of the facilities in which TBFM is installed.

Host Converted Route: The final computerized version of the route of flight taken originally from the field ten route of flight in the flight plan. The process of converting this route of flight involves translating all fixes into standard ones for that area, expanding all short hand expressions to their full form, converting the end of the flight using the active Preferred Arrival Route (PAR), and calculating a predicted time of passage for every fix in the route.

Integrated Enterprise System: The next step in TMA evolution following TBFM development is the Integrated Enterprise System (IES), which potentially integrates TBFM functionality into En Route Automation Modernization (ERAM) or Traffic Flow Management System (TFMS) in the long term, currently estimated by 2025.

Meter Reference Element: Any NAS or user-defined element, including arcs, points, meter fixes, freeze horizons, runway thresholds, and final approach fixes.

Meter Fix: A navigational fix, along an established route, depicted on published instrument approach procedures and charts, used to meter air traffic flows into a TRACON. A typical configuration has four meter fixes distributed evenly around the congested TRACON airspace.

Meter Fix Arc: An arc with a distance equal to the closest meter fix.

Miles-In-Trail: A method of restricting aircraft flow in a stream based on defining a minimum separation distance between aircraft

Minutes-In-Trail: A method of restricting aircraft flow in a stream based on defining a minimum separation time between aircraft.

Monitor and Control: Provides centralized system management of the TBFM system. It manages the computational assets of the system. This includes the initiation and termination of functions, and the collection of status information pertaining to hardware and software functions.

M&C Events: Any state or status change, and any other reportable condition such as hardware and software faults and return-to-normal conditions.

MRE Restrictions: Reductions in capacity due to constraints applied to MREs. Types of constraints include, but are not limited to: Miles-in-Trail, Minutes-in-Trail, arrival rates, and reductions in capacity due to weather.

Outer Fix Arc: An arc at a distance beyond the meter fix.

Route Information: Includes NAS published Departure (SIDs), En Route and Arrival (STARS) routes. These routes include RNAV/RNP SIDs and STARs.

Parameter: Includes any user input.

Proposed Flights: Consist of flight plans only.

Satellite Airports: Airports that lie under or within the airspace of the ARTCC. Usually used by TMA in the sense of airports from which aircraft are departing to go to a TMA-adapted airport.

Schedule: A specific sequenced list of Scheduled Times of Arrival (STAs) and the corresponding times in which each aircraft will cross the runway threshold or other point of reference.

Scheduled Time of Arrival: An STA is the desired time that an aircraft should cross an MRE. It takes other flights, constraints and airspace configuration into account. An STA is the result of the TMA scheduler calculating an arrival time according to parameters such as spacing, aircraft performance, and weather.

Schedule Constraints: Include, but are not limited to:

1. Constraints from outside of FAA
2. Limits imposed by Air Traffic Control to structure normal, standard traffic flows
3. Limits imposed by Air Traffic Management on routing, timing, and spacing as needed
4. Changes to airport configurations, NAVAIDs, etc.
5. FEA, FCA, Volume Constraint.

Scheduler Information: Includes any settings that affect how a schedule is built.

Sector Controller: The generic name for an air traffic controller who is responsible for air traffic in one or more sectors either in an ARTCC or in a TRACON.

STA Lock Point: A time or distance from a MRE at which the flight's STA becomes locked.

System Performance: Includes capacity and response.

Time-Based Metering: A method of restricting aircraft flow by scheduling the time at which each aircraft should cross a predetermined MRE.

Time-to-Fly: Quantity in seconds required to fly from one defined point in airspace to another.

Tracked Flights: Flights which have departed and are being actively tracked by radar. Within TBFM, these flights include flight plans and radar tracks.

Traffic Flow Definition: Parameters for restrictions applied to MREs including flow, MIT, MINIT and type of equipment.

Traffic Management Coordinator: The title for an individual air traffic controller located in the Traffic Management Unit who is responsible for metering traffic as it flows into and out of the ARTCC or TRACON. Under TBFM, the TMC performs the system-wide management of air traffic. The TMC communicates directly with area supervisors (as opposed to communicating directly with pilots). A typical function is that of metering operations, for example, closing gates or controlling the volume to meet acceptable rates. Also known simply as Traffic Manager.

Traffic Management Initiatives: A coordinated plan of action for maintaining a safe and efficient flow of air traffic. Examples of TMIs include ground

	delay programs, airspace flow programs, MIT/MINIT restrictions, altitude capping, and closed routes.
Users:	Includes TMCs and controllers.
Weather Information:	Includes current and forecast weather, atmospheric data, winds, temperature, atmospheric pressure, geo-potential height, terminal weather reports, precipitation, jet streams, radar tops, and lightning.

Appendix C: External Interfaces

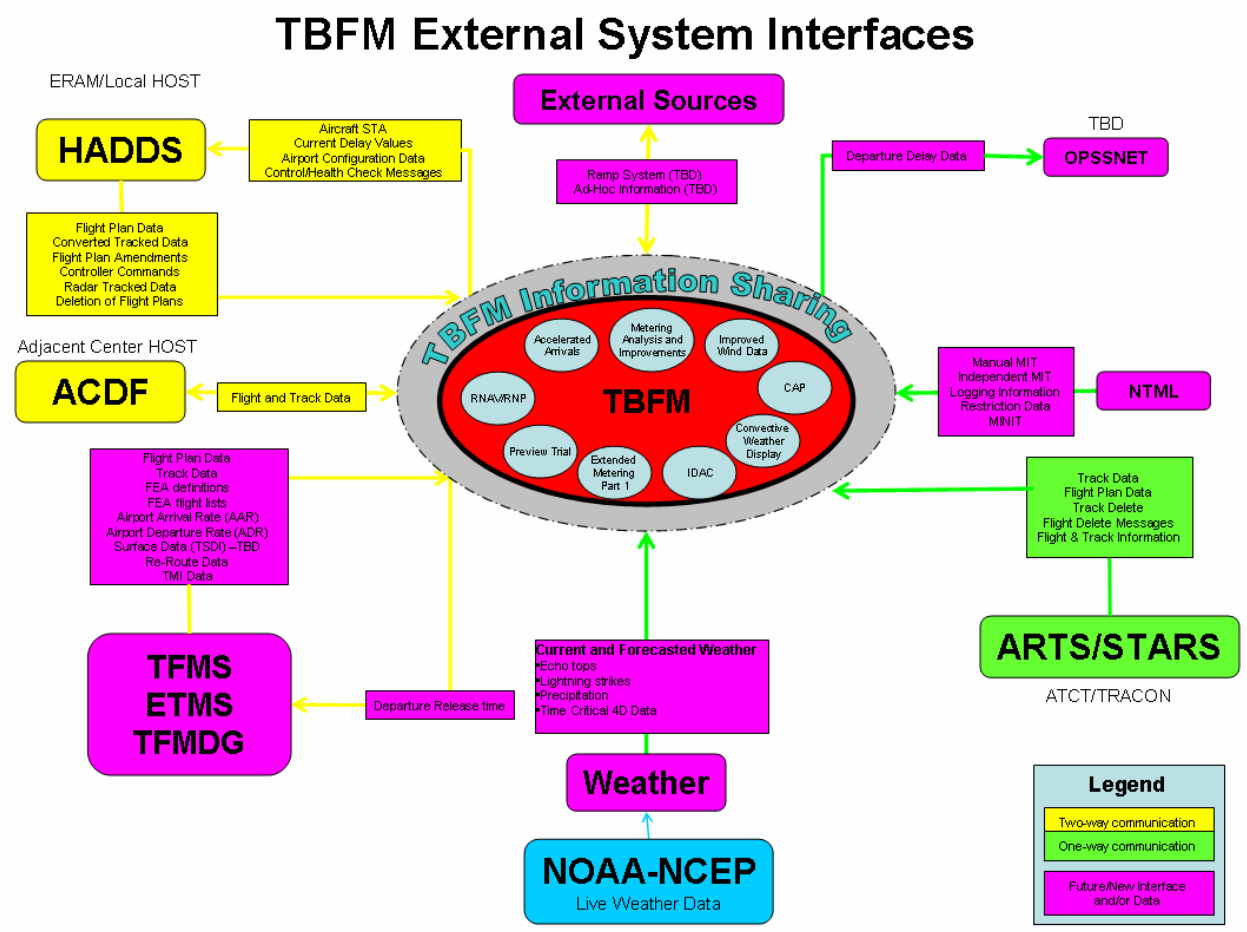

Diagram of System Interfaces